CLAIMS

1. A physical vapor deposition target comprising a material with an face centered cubic unit cell, having a sputtering surface, and comprising:

a predominate <220> crystallographic texture across the sputtering surface; and

an average grain size across the sputtering surface of less than or equal to about 30 microns.

2. The physical vapor deposition target of claim 1 wherein the average grain size across the sputtering surface is less than or equal to 1 micron.

3. The physical vapor deposition target of claim 1 further comprising substantially no pores or voids proximate the sputtering surface.

4. The physical vapor deposition target of claim 1 wherein the predominate <220> crystallographic texture is a strong <220> crystallographic texture.

5. The physical vapor deposition target of claim 1 comprising a ratio of the<220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 80%.

6. The physical vapor deposition target of claim 1 comprising a ratio of the<220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 90%.

7. The physical vapor deposition target of claim 1 wherein substantially all of the grain sizes across the sputtering surface are less than about 30 microns.

8. The physical vapor deposition target of claim 1 wherein substantially all of the grain sizes across the sputtering surface are less than 1 micron.

9. The physical vapor deposition target of claim 1 wherein the <220> texture comprises predominately axial <220> orientations.

10. The physical vapor deposition target of claim 1 wherein the <220> texture comprises predominately planar <220> orientations.

11. The physical vapor deposition target of claim 1 comprising one or more of aluminum, copper, silver, gold, nickel, brass, cerium, cobalt, calcium, iron, lead, palladium, platinum, rhodium, strontium, ytterbium, and thorium.

12. The physical vapor deposition target of claim 1 comprising one or more of aluminum, copper, gold, nickel, and platinum.

13. The physical vapor deposition target of claim 1 wherein any precipitates present in the target have a maximum dimension of 0.5 micron.

14. A method of fabricating a metallic material having a face centered cubic unit cell, comprising:

extruding the metallic material a sufficient number of times to create a substantially random crystallographic orientation distribution within the material; and

after the extruding, cross-rolling the material to induce a predominate <220> crystallographic texture within the material.

15. The method of claim 14 wherein the induced texture is a strong <220> texture.

16. The method of claim 14 wherein the induced texture comprises a ratio of the <220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 80%.

17. The method of claim 14 wherein the induced texture comprises a ratio of the <220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 90%.

18. The method of claim 14 wherein the metallic material is a cast material.

19. The method of claim 14 wherein the extruding comprises passing the material through an ECAE apparatus at least 4 times; each pass through the apparatus comprising passing the material through two intersecting passages having approximately equal cross-sections and arranged at an angle of about 90° relative to one another.

20. The method of claim 14 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron.

21. The method of claim 14 further comprising shaping the material into a substantially rectangular shape prior to the cross-rolling.

22. The method of claim 14 further comprising shaping the material into a substantially circular shape prior to the cross-rolling.

23. The method of claim 14 further comprising, after the cross-rolling, shaping the material into a physical vapor deposition target shape.

24. The method of claim 14 further comprising, after the cross-rolling, recrystallization annealing of the material to induce grain growth within the material.

25. The method of claim 24 wherein the cross-rolling produces the predominate <220> texture within the material as a planar <220> orientation.

26. The method of claim 24 wherein the cross-rolling produces the predominate <220> texture within the material as an axial <220> orientation.

27. The method of claim 14 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron; and further comprising conducting the cross-rolling at a temperature higher than a static recrystallization temperature of the material to induce grain growth within the material and obtain substantially all grain sizes within the material of from 1 micron to about 30 microns.

28. The method of claim 27 wherein the cross-rolling produces the predominate <220> texture within the material as a planar <220> orientation.

29. The method of claim 27 wherein the cross-rolling produces the predominate <220> texture within the material as an axial <220> orientation.

30. The method of claim 14 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron; and further comprising conducting the cross-rolling at a temperature less than a static recrystallization temperature of the material to maintain the grain sizes of the extruded material during the cross-rolling.

31. The method of claim 30 wherein the cross-rolling produces the predominate <220> texture within the material as a planar <220> orientation.

32. The method of claim 30 wherein the cross-rolling produces the predominate <220> texture within the material as an axial <220> orientation.

33. The method of claim 14 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron; and further comprising, after the cross-rolling, recrystallization annealing of the material to induce grain growth within the material to obtain an average grain size within the material of from 1 micron to about 30 microns.

34. The method of claim 14 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron; and further comprising, after the cross-rolling, recovery annealing of the material.

35. The method of claim 34 wherein the recovery annealing of the material is at a temperature of at least about 150°C for a time of at least about 1 hour.

36. The method of claim 34 wherein substantially all of the grain sizes within the extruded material remain at less than 1 micron after the cross-rolling and recovery annealing.

37. The method of claim 34 wherein the cross-rolling produces the predominate <220> texture within the material as a planar <220> orientation.

38. The method of claim 34 wherein the cross-rolling produces the predominate <220> texture within the material as an axial <220> orientation.

39. The method of claim 14 further comprising, before the cross-rolling, forging the material.

40. The method of claim 39 further comprising, after the forging and before the cross-rolling, recrystallization annealing of the material.

41. The method of claim 39 further comprising, after the forging and before the cross-rolling, recovery annealing of the material.

42. The method of claim 41 wherein the recovery annealing is at a temperature of at least about 150°C for a time of at least about 1 hour.

43. The method of claim 14 wherein the cross-rolling comprises at least two passes of the material through a cross-rolling apparatus, and further comprising recrystallization annealing of the material between the at least two passes.

44. The method of claim 14 wherein the cross-rolling comprises at least two passes of the material through a cross-rolling apparatus, and further comprising recovery annealing of the material between the at least two passes.

45. The method of claim 14 wherein the cross-rolling comprises at least two passes of the material through a cross-rolling apparatus, and wherein the at least two passes are conducted at perpendicular orientations of the material relative to one another.

46. The method of claim 45 wherein the material is in a rectangular shape during the cross-rolling.

47. The method of claim 14 further comprising shaping the material into a substantially circular shape prior to the cross-rolling; and wherein the cross-rolling comprises at least 4 cross-rolling passes across a surface of the material.

48. The method of claim 14 further comprising shaping the material into a substantially circular shape prior to the cross-rolling; and wherein the cross-rolling comprises at least 4 cross-rolling passes across a surface of the material; the at least 4 cross-rolling passes being along separate axes relative to one another; the separate axes being equi-distantly spaced around a circular outer periphery of the circular shape of the material.

49. A method of fabricating a metallic material having a face centered cubic unit cell, comprising:

extruding the metallic material a sufficient number of times to create a substantially random crystallographic orientation distribution within the material; and

after the extruding, forging the material to induce a predominate <220> crystallographic texture within the material.

50. The method of claim 49 wherein the induced texture is a strong <220> texture.

51. The method of claim 49 wherein the induced texture comprises a ratio of the <220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 80%.

52. The method of claim 49 wherein the induced texture comprises a ratio of the <220> crystallographic orientation to all other orientations of the face centered cubic unit cell of at least about 90%.

53. The method of claim 49 wherein the metallic material is a cast material.

54. The method of claim 49 wherein the extruding comprises passing the material through an ECAE apparatus at least 4 times; each pass through the apparatus comprising passing the material through two intersecting passages having approximately equal cross-sections and arranged at an angle of about 90° relative to one another.

55. The method of claim 49 further comprising shaping the material into a substantially circular shape prior to the forging.

56. The method of claim 49 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron.

57. The method of claim 56 wherein the forging is conducted at a temperature higher than a static recrystallization temperature of the material; the forging producing the predominate <220> texture within the material to have an axial <220> orientation, the grain size produced by the extruding increasing during the forging to an average grain size of from 1 micron to about 30 microns.

58. The method of claim 56 wherein the forging is conducted at a temperature less than a static recrystallization temperature of the material to produce the predominate <220> texture within the material to be an axial <220> orientation, and to substantially maintain the grain size produced by the extruding.

59. The method of claim 49 further comprising, after the forging, shaping the material into a physical vapor deposition target shape.

60. The method of claim 49 wherein the extruding is conducted a sufficient number of times that substantially all of the grain sizes within the extruded material are less than 1 micron; and further comprising, after the forging, recrystallization annealing of the material to induce grain growth within the material to obtain an average grain size within the material of from 1 micron to about 30 microns.

61. The method of claim 49 further comprising, after the forging, recovery annealing of the material at a temperature and time less than those providing static recrystallization of the material.

62. The method of claim 49 further comprising, after the forging, recovery annealing of the material at a temperature of at least about 150°C for a time of at least about 1 hour.

63. The method of claim 49 further comprising, before the forging, cross-rolling the material.

64. The method of claim 63 further comprising, after the cross-rolling and before the forging, recovery annealing of the material at a temperature and time less than those providing static recrystallization of the material.

65. The method of claim 63 further comprising, after the cross-rolling and before the forging, recovery annealing of the material at a temperature of at least about 150°C for a time of at least about 1 hour.

66. The method of claim 63 further comprising, after the cross-rolling and before the forging, recrystallization annealing of the material.